CLAIMS

What is claimed is:

1. A method, comprising performing an expose period of an atomic layer deposition (ALD) process using a first purge flow and a first pumping capacity, and performing a purge period of the ALD process using a second purge flow greater than the first purge flow and a second pumping capacity greater than the first pumping capacity.

2. The method of claim 1, further comprising maintaining a pressure of a reactor chamber within which the ALD process is performed nominally constant during the expose period and the purge period.

3. The method of claim 2, wherein the pressure of the reactor chamber is maintained nominally constant through operation of a throttle valve downstream from the reactor chamber such that the throttle valve is more open during the purge period than during the expose period.

4. The method of claim 1, wherein the first purge flow and the second purge flow comprise different gasses.

5. The method of claim 1, wherein the first purge flow and the second purge flow are provided through different flow paths.

6. The method of claim 1, wherein the second purge flow and second pumping capacity are activated prior to termination of material deposition during the expose period.

7. The method of claim 1, wherein the second purge flow and second pumping capacity are activated so as to break existing turbulence within a reactor chamber within which the ALD process is performed.

8. The method of claim 1, further comprising performing a second expose period of the ALD process using a third purge flow and a third pumping capacity different from the first purge flow and first pumping capacity, respectively.

9. The method of claim 8, wherein the third purge flow comprises an absence of a purge flow.

10. The method of claim 1, wherein the expose period comprises a plasma-assisted process.

11. The method of claim 1, wherein the first purge flow is switched to the second purge flow at a substantially coincident point in time as the first pumping capacity is switched to the second pumping capacity.

12. The method of claim 11, wherein the first purge flow is switched to the second purge flow prior to completion of material deposition during the expose half-cycle.

13. The method of claim 1, wherein the first purge flow is switched to the second purge flow at a different point in time than that at which the first pumping capacity is switched to the second pumping capacity.

14. The method of claim 13, wherein the first purge flow is switched to the second purge flow before the first pumping capacity is switched to the second pumping capacity.

15. The method of claim 13, wherein the first purge flow is switched to the second purge flow after the first pumping capacity is switched to the second pumping capacity.

16. The method of claim 1, wherein the first purge flow is switched to the second purge flow by switching first flow limiting conductances located upstream of a reactor chamber within which the ALD process is performed out of a first gas flow path to the reactor chamber at a substantially coincident point in time as second flow limiting conductances located downstream of the reactor chamber are switched out of a second gas flow path from the reactor chamber.

17. A method, comprising performing a first period of an atomic layer deposition (ALD) cycle using a first purge flow defined in part by a first conductance of an annular gas flow pathway within a reactor chamber in which the ALD process takes place, and performing a second period of the ALD cycle using a second purge flow greater than the first purge flow, the second purge flow defined in part by a second conductance of the annular gas flow pathway within the reactor chamber.

18. The method of claim 17, further comprising maintaining a pressure of the reactor chamber nominally constant during the first period and the second period.

19. The method of claim 17, wherein the first purge flow and the second purge flow comprise different gasses.

20. The method of claim 17, wherein the first purge flow and the second purge flow are provided through different flow paths.

21. The method of claim 17, wherein the second purge flow is activated prior to termination of material deposition during the first period.

22. The method of claim 17, further comprising performing a third period of the ALD cycle using a third purge flow defined in part by a third conductance of the annular gas flow pathway and different from the first and second purge flows.

23. The method of claim 22, wherein the third purge flow comprises an absence of a purge flow.

24. The method of claim 17, wherein the first period comprises a plasma-assisted process.

25. The method of claim 1, wherein the first purge flow is switched to the second purge flow in part by switching first flow limiting conductances located upstream of the reactor chamber out of a first gas flow path to the reactor chamber at a substantially coincident point in time as the second conductance of the annular gas flow pathway within the reactor chamber is switched into a second gas flow path from the reactor chamber.

26. A method, comprising performing an expose period of an atomic layer deposition (ALD) process using a first purge flow at a first pressure, the first purge flow passing through a first flow limiting conductance located within a first gas flow pathway upstream of a reactor chamber within which the ALD process is performed and a second flow limiting conductance located within a second gas flow pathway downstream of the reactor chamber, and performing a purge period of the ALD process using a second purge flow at a second pressure greater than the first pressure, the second purge flow passing through a third conductance located within the first gas flow pathway and a fourth conductance

located in the second gas flow pathway, wherein a ratio of the first conductance to the second conductance is equal to a ratio of the third conductance to the fourth conductance and a pressure of the reactor chamber is maintained nominally constant during the ALD process.

27. The method of claim 26, wherein a second purge gas used for the second purge flow is different from a first purge gas used for the first purge flow.

28. The method of claim 26, wherein the expose period comprises a plasma-assisted process.

29. The method of claim 26, wherein the first purge flow is switched to the second purge flow at a substantially coincident point in time as the first conductance within the first gas flow pathway is switched to the third conductance.

30. The method of claim 26, wherein the first purge flow is switched to the second purge flow prior to completion of material deposition during the expose period.

31. The method of claim 26, wherein the first purge flow is switched to the second purge flow at a different point in time than that at which the second conductance in the second gas flow pathway is switched to the fourth conductance.

32. An atomic layer deposition (ALD) system, comprising:

a first purge flow pathway coupled upstream of a reactor;

a second purge flow pathway coupled upstream of the reactor; and

a pumping arrangement coupled downstream of the reactor, and configured to be switched between a first pumping capacity when the first purge flow pathway is active and a second pumping capacity greater than the first pumping capacity when the second purge flow pathway is active.

33. The ALD system of claim 32, wherein the first and second purge flow pathways share a common gas flow manifold with one or more precursor injection pathways.

34. The ALD system of claim 32, wherein at least one of the first and second purge flow pathways is directly coupled to the reactor independently of the other.

35. The ALD system of claim 32, wherein the first and second pumping capacities comprise two operational modes of a single physical pump.

36. The ALD system of claim 32, further comprising a throttle valve downstream of the reactor chamber.

37. The ALD system of claim 36, wherein the second pumping capacity is provided, at least in part, by a physical pump coupled downstream of the reactor chamber but upstream of the throttle valve.

38. The ALD system of claim 36, wherein the first and second pumping capacities are provided by one or more pumps coupled downstream of the throttle valve.

39. The ALD system of claim 32, wherein the first and second purge flow pathways are configured to operate at first and second purge gas pressures, respectively, the first pressure being less than the second pressure.

40. The ALD system of claim 39, wherein the first and second purge flow pathways share a common gas flow manifold with one or more precursor injection pathways.

41. The ALD system of claim 39, wherein at least one of the first and second purge flow pathways is directly coupled to the reactor independently of the other.

42. An atomic layer deposition (ALD) system, comprising:

a purge flow pathway coupled upstream of a reactor chamber through selectable upstream flow limiting conductances having two or more operational modes including a low flow mode and a high flow mode; and

a pumping arrangement coupled downstream of the reactor through selectable downstream flow limiting conductances having two or more operational modes including a low flow mode and a high flow mode,

wherein the upstream flow limiting conductances and downstream flow limiting conductances are configured to switch operational modes in time-phase with one another.

43. The ALD apparatus of claim 42, wherein the upstream flow limiting conductances are configured to switch operational modes prior to the downstream flow limiting conductances switching operational modes.

44. The ALD apparatus of claim 42, wherein the downstream flow limiting conductances include a throttle valve.

45. The ALD apparatus of claim 44, wherein the throttle valve comprises an annular throttle valve located within the reactor chamber.

46. The ALD apparatus of claim 42, wherein the purge flow pathway comprises multiple gas flow pathways for purge gasses and chemical precursors which share one or more common inputs to the reactor chamber.

47. The ALD apparatus of claim 46, wherein at least one of the purge gas flow pathways is independent of the gas flow pathways for the chemical precursors.

48. An atomic layer deposition (ALD) system, comprising a gas delivery system coupled to a reactor chamber having disposed therein an annular throttle valve positioned within a gas flow pathway from the reactor chamber to a pumping system coupled downstream of the reactor chamber.

49. The ALD system of claim 48, wherein the annular throttle valve has two or more operating modes, each configured to provide a different flow path conductance from the reactor chamber.

50. The ALD system of claim 49, wherein the gas delivery system is configured to provide purge flows at two or more flow levels.

51. The ALD system of claim 50, wherein the annular throttle valve is coupled to a control system configured to switch operating modes of the annular throttle valve according to a level of purge flow so as to maintain a nominally constant reactor chamber pressure.

52. The ALD system of claim 48, wherein the annular throttle valve includes multiple vanes, each having an axis therethrough about which an individual vane rotates from a first position to a second position.

53. The ALD system of claim 48, wherein the annular throttle valve includes multiple blades arranged in an iris configuration.

54. The ALD system of claim 48, wherein the annular throttle valve includes multiple blades, each having a number of holes therethrough, at least one of the blades being rotatable about an axis such that holes extending through the rotatable blade align with holes of at least one of the other blades to provide a passage through the annular throttle valve.

55. An ALD apparatus, comprising a first neutral gas line configured to inject an Ar gas flow level into a reaction space during a purge period of an ALD cycle, and a distinct, second neutral gas line configured to inject an N_2 gas flow level downstream of the reaction space, the gas flow levels being selected so as to provide for substantially constant pressure in the reaction space.